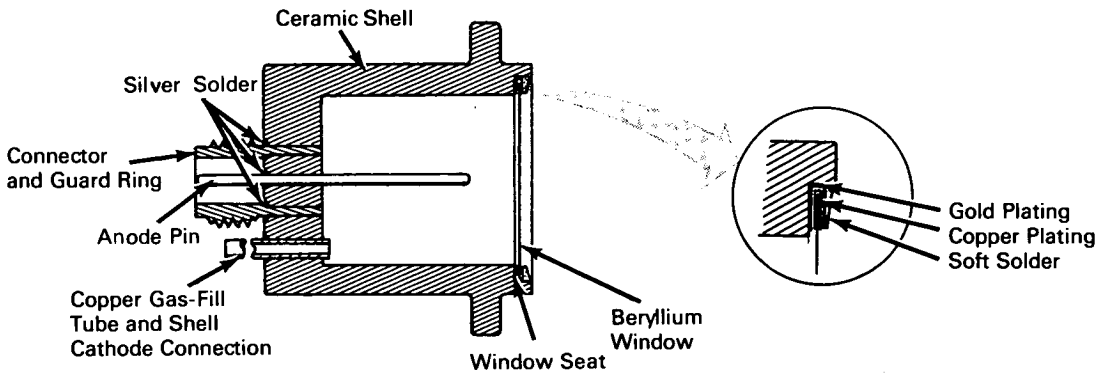
NASA TECH BRIEF

An Improved Soft X-Ray Photoionization Detector



The problem:

To design a compact, rugged gas-filled photoionization chamber or detector for measuring very small incident photon fluxes from soft X-rays. The detector must have high spectral selectivity, relatively high quantum efficiencies, and a long shelf life.

The solution:

A photoionization detector (overall length, 1.50 inches; outside diameter, 1.375 inches) incorporating a shell of high-density alumina, a beryllium foil window, and a xenon (or argon) gas fill. Meticulous attention is given to fabrication details to minimize electrical leakage between electrodes and photoelectric emission from the chamber walls, to prevent recontamination of the filling gas after purification, and to provide window and connector seals that will hold a high vacuum (better than 10^{-6} torr).

How it's done:

The ceramic shell of high-density fused alumina (available from commercial sources) is sequentially coated on most of its interior surface with molybdenum-manganese (metalizing), a flash plating of nickel, a plating of copper, and a sintered gold plate. Brazed into the unplated rear face of the shell are a central pin anode consisting of a commercially available glass-sealing alloy (20 percent Ni, 17 percent Co, 0.2 percent Mn, balance Fe), a guard ring and connector of the same alloy, and a copper gas-fill tube, which also provides the electrical connection to the cathode formed by the metal plating on the interior surface of the shell.

The window material consists of hot-rolled beryllium foil having a thickness of 0.005 inch and a diameter of 0.860 inch. The periphery of the beryllium window disk is electroplated with copper using a specially developed procedure and plating bath. The disk is then prepared for peripheral bonding to the gold plated window seat of a previously prepared shell. A 60:40 lead-tin solder is used for bonding the two components to form a vacuum-tight window seal.

The chamber assembly is tested to ensure leak-free joints and then filled with xenon. The gas-filled chamber is valved off from the gas supply system, and the stem of the fill tube is sealed with a commercial pinch-off tool and snipped from the system. Solder is applied to the stem tip to provide additional protection against leakage. The completed

(continued overleaf)

chamber is calibrated before use to determine its quantum efficiency or photoionization yield.

Notes:

1. Detectors of this design have been successfully used in several solar rocket probes. They should be of value in laboratories wherever stable photoionization detectors are required for measurement of soft X-ray radiation.
2. The design of this detector is patterned after the vacuum ultraviolet ion chambers (incorporating other window materials and gas fills) previously developed at the Goddard Space Flight Center.
3. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland 20771
   Reference: B67-10072

Patent status:

No patent action is contemplated by NASA.

Source: Robert M. Young and Alfred K. Stober (GSFC-540)